Pioneer Anomaly and Dimensions of Time

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Abstract

The emergence and dimensions of Time are analyzed here on the basis of Newton gravitation law. The new conception proposes that Time does not exist independently. The Time is the acceleration rate of the Universe expansion. Time has three dimensions: one is in the direction from Past to Future and two dimensions of the Present. The cause of Pioneer anomaly is taking into account only one time dimension of the Present.

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Introduction

The spacecraft Pioneer 10 was launched in 1972 and Pioneer 11 was launched in 1973. An anomalous blue-shifted Doppler frequency drift was observed in 1980 after the said spacecraft passed about 20 astronomical units (3E+9 km) on their trajectories out of the Solar System. It was interpreted as due to a constant sunward acceleration of a Pioneer [1]. The effect got the name “Pioneer anomaly”.

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The solution of the Pioneer 10 mystery was found 30 years later as anisotropic heat radiation [2]. A detailed investigation of all other distant spacecraft was not performed because it was presumed that the cause of their anomalies could be similar to Pioneer 10.

Time in the Universe

The gravitational acceleration *g* according to Newton gravitation law is equal to the second derivative from distance as shown in equation (1):

$$g=\frac{d^2 r}{\mathrm{dt}^2}=-\frac{\mathrm{GM}}{r^2} \qquad \textbf{(1)}$$

where: *G* - gravitational constant
M – mass
r – distance.

Equation (1) can be transformed in differential equation (2):

$$r^2 \frac{d^2 r}{dt^2} + GM = 0 \qquad (2)$$

The differential equation (2) has a solution only if at the initial moment of time $t = 0$, initial distance $r = 0$ and initial velocity $dr/dt = 0$.

The solution of equation (2) is shown in equation (3):

$$2/3\ r^3 = 3GMt^2 \qquad \textbf{(3)}$$

The Gravitation eigenspace emerges from mass *M* at the time moment *t* after *"Big Bang"*. Since all the directions of space are equal, the shape of the Gravitation space is a sphere. The volume of the sphere is arrived at by multiplying both sides of equation (3) by 2π as shown in equation (4):

$$V_G=\frac{4}{3}\pi r^3=6\pi \mathrm{GMt}^2 \qquad \textbf{(4)}$$

The absolute time t from the beginning of the Universe is obtained from equation (4) and is shown in equation (5):

$$t^2 = \frac{V_G}{6\pi GM} = (6\pi G\rho)^{-1} = H^{-2}, \qquad (5)$$

Where: ρ – density of the Universe, H – Hubble's constant.

According to equation (5) the Present in the Universe is a two dimensional surface of the time sphere with radius t as shown in equation (6):

$$S_t = 4\pi t^2 = \tfrac{2}{3}(\rho G)^{-1}, \qquad (6)$$

Each surface point of the time sphere is associated with an appropriated volume unit of the Universe. The inside time sphere is the Past, the surface is the Present and the outside is the Future as shown in Figure 1.

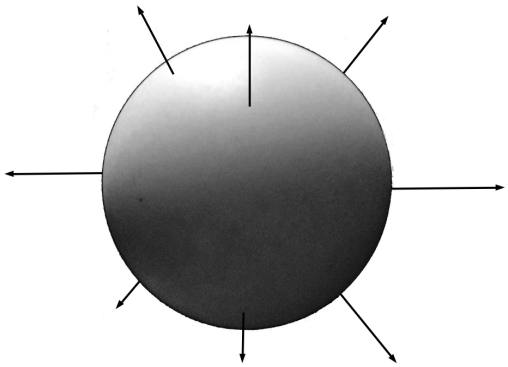

Fig.1. Time sphere

All arrows of time are directed from Past to Future. The inside is the Past. The surface is the Present and the outside is the Future. Each point of the surface is associated with an appropriate volume of the Universe in the Present. The arrows of time represent the expansion rate of the Universe in space. Actual is only the Present. The Past does not exist anymore, but the Future has not emerged yet.

The time relationship between the Earth and a distant galaxy represents a cross section of one sector of the time sphere as shown in Figure 2.

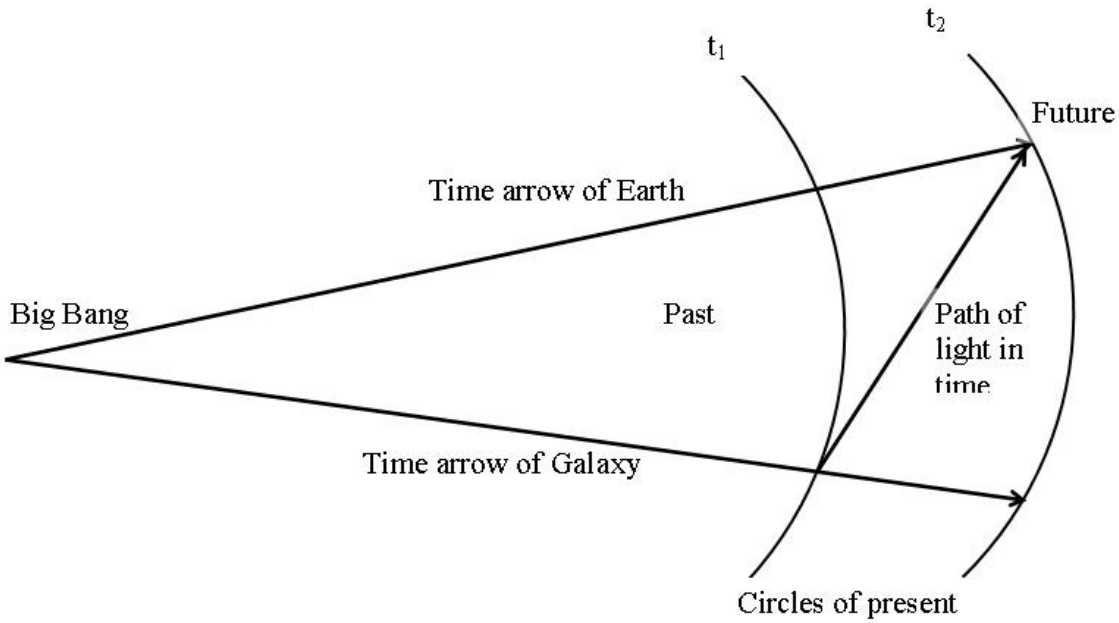

Fig. 2. Time coordinates of Earth and distant galaxy.

Universal time t from the beginning of the Universe is in inverse to Hubble's constant: $t = 1/H$. The Earth and a distant galaxy have different time arrows. At the time moment t_1 the galaxy emits light, which reaches the Earth at the time moment t_2. The path of light in time coordinates extends in comparison with the time between moments of emitting t_1 and receiving t_2. The time flow on the galaxy and on the Earth both is equal to t_2-t_1.

The time flow is extended for photons reaching the Earth. The energy of photons is constant; for that reason the frequency of photons is also constant. It means that due to the extended time the number of electric and magnetic field oscillations in the photons increase. In the time domain on the Earth the said increase of oscillations is received as a frequency blue shift as shown in Fig. 3. The blue shift increases with the distance between the Earth and the galaxy.

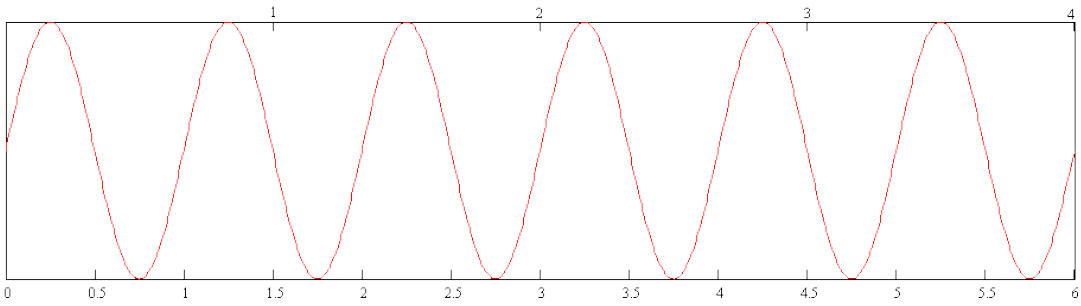

Fig. 3. Time flow on the Earth (upper scale) and for photon (lower extended time scale) both between universal time moments $t_1 = 0$ and t_2.

For example, the frequency 1 GHz of oscillation should be recorded on the Earth as 1.5 GHz or blue shifted.

Exactly the same is true for distant objects such as spacecraft Pioneer, Galileo, Ulises.

The travel of Pioneer in time coordinates is shown in Fig. 4.

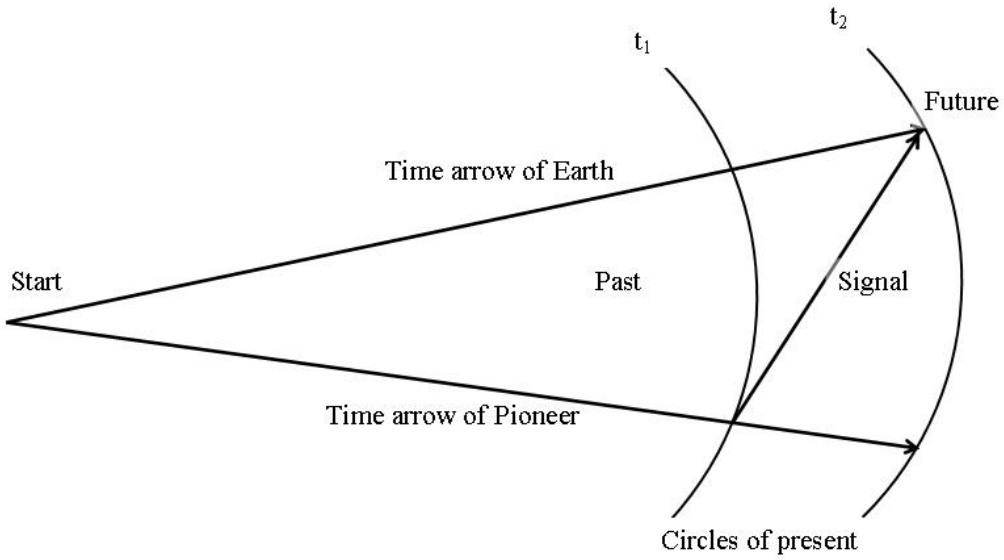

Fig. 4. Pioneer travel in time coordinates:

t_1 – time moment when Pioneer sent a signal,
t_2 – time moment when the Earth received the signal.

The time flow on the Earth and on Pioneer is equal to $t_2 - t_1$, but the time flow for a signal is extended. Hence the signal received on the Earth is blue shifted. There is no anomaly. It is Pioneer effect.

Conclusions

All electromagnetic signals are blue shifted in cosmic scale distances. The magnitude of shift increases with the distance between the observer and the object. This is confirmed by the observation of distant spacecraft: Pioneer 10/11, Galileo and Ulysses. One must use three coordinates of space and two coordinates of time for exact setting coordinates of an object.

Considering that the radius of time sphere is t = 13.7 e+9 years, for small distances such as the size of the Earth, the inaccuracy of time coordinates is miserable. In the cosmic scale the second dimension of time makes an interpretation disparity of measurements.

References

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